physiological deductions. The experiments brought out three important facts, namely, (1) adaptation (20–30 minutes stay in darkness) affects the sensibility for colors unequally. Beginning at zero for the red, the improvement increases as the wave-length shortens till for the violet it is very considerable; (2) adaptation does not make the colors seem more intense as colors, but only more luminous, as if white light had been added; and this may reach such a pitch with very faint lights that the colors are wholly lost in the white light; (3) the sensibility of the *fovea* is unaffected by adaptation.

On these facts Parinaud bases a theory of the rods and cones and the visual purple. In the *fovea* there are cones only, and, as everywhere, they are without purple. Adaptation appears to be an affair of the rods and the purple; it takes place where they are found, and fails where they are absent. Since the luminosity alone is affected, it is natural to regard them as an end-organ for luminosity only, leaving the cones to mediate color. The matter is not so simple, however, as a mere separation of the organs, for the cones must also mediate white, and, indeed, in Parinaud's opinion, could do nothing more than that without the coöperation of the cerebral centers. Hemeralopia (night-blindness), which appears to be due to a deficiency in the purple, confirms this theory of its function, as also does the good development of the rods and purple in the eyes of nocturnal animals. The purple is able to increase the effect of faint lights because of a fluorescent or phosphorescent property. Parinaud's arguments for such a property make a very plausible case. If he is correct the purple becomes an agent for the actual production of light on faint luminous stimulation instead of an agent for increasing the irritability of the visual apparatus. The paper concludes with a fairly full account of the work of other observers in related lines.* The contribution is important in bringing together a number of more or less disregarded facts and showing their very great physiological significance.

E. C. SANFORD.

*The reviewer hastens to withdraw his criticism of the first part of M. Parinaud's paper for deficiency in this respect.

Geology of the Green Mountains in Massachusetts. By RAPHAEL PUMPELLY, J. E. WOLFF and T. NELSON DALE. Monograph XXIII of the United States Geological Survey. 1894. 4°. Pp. xiv, 206. Plates 23. Price $1.30.

The monograph before us is the most detailed and valuable contribution yet made to the solution of the much debated 'Taconic question,' than which none other has achieved greater prominence or excited more bitter feeling in the last fifty years of American geology.

Since the discovery of actual fossils in the metamorphosed strata of Vermont by the Rev. Augustus Wing, the labors of many have indicated the true relations that are now demonstrated, yet nevertheless the difficulties of the problem were so great, and the tendency to generalize without detailed field work had been so marked, that Mr. Pumpelly and his co-laborers decided to throw aside all previous conclusions and by detailed and patient observation, based upon topographic maps in a crucial area, to trace out step by step the relations of these much disturbed and metamorphosed sediments. Accordingly the northwest corner of Massachusetts was selected and study was focused especially upon Hoosac Mountain on the east, Greylock Mountain on the west and the valley between. Hoosac Mountain, well known for the famous tunnel that penetrates it, is an anticlinorium with a core of granitic pre-Cambrian gneiss (the Stamford gneiss), on which rests, with conformable lamination, another variable white gneiss that is at times a recognizable conglomerated and even a quartzite (the Vermont formation). Above the last and still conformable is a great thickness of albite schist (the Hoosac schist), which is itself succeeded on the east by the Rowe schist. The Vermont formation is Cambrian; the Hoosac schist is Cambrian below, Silurian above. The Rowe schist is Silurian and of minor importance in the problem. On the west side of Hoosac Mountain the Hoosac schist fails and the Vermont formation runs under the Cambro-Silurian Stockbridge limestone that has been degraded to form the valley. It should be remarked that all the strata of Hoosac Mountain proper, except the Stamford gneiss, are metamorphosed *clastics*.

Greylock Mountain, with its spurs, is a

double synclinorium, whose lowest member is the Cambro-Silurian Stockbridge limestone. This is succeeded by the Berkshire schist, the Bellowspipe limestone and the Greylock schist, all Silurian. Now, the interesting geological thesis established by the monograph is that the metamorphosed clastics of the Hoosac Mountain are the shore deposits, which in the case of the Hoosac schist correspond to the deeper water, Stockbridge and Bellowspipe limestones and their accompanying schists. The determination throws a flood of light on the entire stratigraphy of the region, and simplifies the problem of the Green Mountains. The difficulties that were overcome in tracing out these metamorphic schists to their original sediments, in proving the uncomformability of the Vermont conglomerate gneiss upon the Stamford gneiss, when the foliation was the same in both, and the neat way in which it was done by the discovery of the eroded and depressed pre-Cambrian outcrop of a trap dike in the Stamford gneiss, which was buried under the Vermont formation, all called for patient study and close observation in the highest degree. And when the passage of the Hoosac schists into the Stockbridge limestone was finally established, a very hard problem was at last solved. The authors are to be warmly complimented and congratulated on their success.

Besides the stratigraphic results, many important contributions are made to our knowledge of the general metamorphism of sediments to crystalline schists.

The three authors were also aided in a degree calling for mention by Mr. B. T. Putnam, whose untimely death removed him in the midst of his career, and by Prof. W. H. Hobbs. The report is richly illustrated with that profusion of maps and plates which is only attainable in this country by attachés of the United States Survey. The investigations have been continued on the south by Professor Dale, whose later results are published in the Fourteenth Annual Report of the Director as reviewed in these columns, p. 632.

J. F. KEMP.

The Laccolitic Mountain groups of Colorado, Utah and Arizona. WHITMAN CROSS. 14th Annual Report of the Director of the U. S. Geological Survey, Washington, 1894. Pp. 165–241. Pt. ii.

Mr. Cross makes in this paper the second considerable contribution to our knowledge of laccolites, the first having been made by Gilbert in 1877. The West Elk Mountains, in Colorado, including Ragged Mount, Mt. Marcellina, the Anthracite range, Mt. Axtell, Mt. Carbon, Mt. Wheatstone, Crested Butte, Gothic Mount and probably others in the same group, are laccolitic in origin. So also are the San Miguel Mountains, about 70 southwest of the West Elk group. Still farther south, at a distance of 25 miles, the La Plata Mountains form a remarkable group of laccolites. About 65 miles farther south-west, in the northeastern corner of Arizona, lie the Carriso Mountains, the laccolitic nature of which is not positively stated. El Late Mountains, in the southwestern corner of Colorado, are believed to be laccolites. Next, the Abajo Mountains of eastern Utah are compared with the laccolites of the type area, and the La Sal Mountains, about 35 miles north of the Abajo Mountains, are only doubtfully considered as due to intrusions. In discussing the conditions of intrusion in laccolites, Mr. Cross concludes in agreement with Dana that Gilbert's explanation of the incoming of the magma into the strata is complete without reference to the relations which may exist between the densities of the lava and the stratified rocks.

Comment: The time of formation of laccolites and volcanoes in the same field seems not yet to be fully determined, but in two of the areas described it is probable that laccolites were first formed and subsequently dikes and volcanic rocks were formed, the former appearing at the present denuded surface and the latter having poured out upon the surface. If this order should prove generally true, it would agree with that observed in the case of small intrusions in the Boston basin. Thus in the slate area bordering the Mystic River there are at least three series of intrusions in the form of dikes and sills. The sills, here the analogues of laccolites, are in every instance connected with the earliest movements of the magma. Moreover, the sills came in before the